METHOD FOR MANUFACTURING NITRIDE LIGHT-EMITTING DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a method for manufacturing nitride light-emitting device, and particularly to a manufacture method, which is to lay a light-emitting structure of nitride on a high thermal conductivity substrate by transference due to the formation of a bonding layer.

2. The Prior Arts

[0002] An aluminum oxide (Al_2O_3) substrate is generally used in a common manufacture method of the prior nitride light-emitting device for growing epitaxy thereon. However, the effective lighting area of epitaxial grains has been lessened because both the P- and the N-type electrodes are inevitably arranged on the same side due to the insulating property of the substrate itself. Because the conductivity of the P-type nitride is far lower than that of the N-type, a translucent metallic conductive layer is adopted to serve for an ohmic contact layer for distributing current uniformly, which reduces light emitting efficiency significantly.

SUMMARY OF THE INVENTION

[0003] Therefore, a method for manufacturing nitride light-emitting device of the present invention by means of chip-bonding technology is disclosed for eliminating the defects in the prior arts. Also, in view of the poor thermal conductivity of the insulating aluminum oxide substrate mentioned in foregoing background, the present invention is to fix two metallic bonding layers together in order to bond a nitride lighting structure grown on a poor thermal conductivity substrate to a high thermal conductivity substrate, then remove the poor thermal conductivity substrate by means of chemical etching, dry etching, or mechanical abrading to thereby transfer the nitride lighting structure onto that high thermal conductivity substrate.

[0004] The primary object of the present invention is, on the one hand, to form an epitaxial layer of a nitride lighting structure on a high thermal conductivity substrate and prepare a vertical single lead wire structure, an N-type or P-type electrode for example, to hence lessen the light-shading area. On the other hand, an ohmic contact layer is formed to connect a transparent conductive layer with the N-type nitride epitaxial layer to have current distribution and light emitting efficiency improved significantly.

[0005] Another object of the present invention is to provide a method for manufacturing a light emitting device on a high thermal conductivity substrate with reliable stability under a relatively larger working current.

[0006] Yet, another object of the present invention is to provide a vertical electrode structure requiring only a single lead wire to therefore save considerable package cost.

[0007] For more detailed information regarding advantages or features of the present invention, at least an example of preferred embodiment will be described below with reference to the annexed drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The related drawings in connection with the detailed description of the present invention to be made later are described briefly as follows, in which:

[0009] Figure 1 shows a schematic lighting structure of nitride according to a method for manufacturing nitride light-emitting device of the present invention;

[0010] Figure 2 shows a schematic high thermal conductivity substrate according to the method for manufacturing nitride light-emitting device of the present invention;

[0011] Figure 3 shows a schematic bonding of the high thermal conductivity substrate and the lighting structure of nitride according to the method for manufacturing nitride light-emitting device of the present invention;

[0012] Figure 4 shows that the lighting structure of nitride is transferred onto the high thermal conductivity substrate according to the method for manufacturing nitride light-emitting device of the present invention;

[0013] Figure 5 shows schematically a transparent conductive layer according to the method for manufacturing nitride light-emitting device of the present invention;

[0014] Figure 6 shows schematically an N-type and a P-type electrode according to the method for manufacturing nitride light-emitting device of the present invention; and

[0015] Figure 7 shows a flowchart according to the method for manufacturing nitride light-emitting device of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0016] Figure 1 shows a schematic lighting structure of nitride according to a method for manufacturing nitride light-emitting device of the present invention. As shown in Figure 1, a lighting structure **20** according to a method for manufacturing nitride light-emitting device of the present invention comprises: a first substrate **201** made of aluminum oxide (Al_2O_3); an N-type nitride epitaxial layer **203**, which is an epitaxial structure layer formed on the first substrate **201** by way of currently known epitaxial growth technology; and a P-type nitride epitaxial layer **205**, which is also an epitaxial structure layer formed on the N-type nitride epitaxial layer **203** by the same technology growing the N-type nitride epitaxial layer **203**.

[0017] For a bonding operation to be performed later, a first bonding layer **21** is grown on the P-type nitride epitaxial layer **205** of the nitride lighting structure **20** by depositing, sputtering, electroplating or other known techniques. In this case, depositing is adopted. Indium-tin alloy is a preferred material, and 1μm is a preferred thickness. Other than the indium-tin alloy, at least any metal chosen from any combination of Al, Ag, Au, Ni, Cu, Pt, Ti, and Pt can be used.

[0018] Figure 2 shows a schematic high thermal conductivity substrate according to the method for manufacturing nitride light-emitting device of the present invention. As shown in Figure 2, the method of the present invention requires a second high thermal conductivity substrate **30** made of any of semiconductors, metals, and alloys, having a thermal conductive coefficient higher than 150W/m-K. Aluminum is taken as an example in the embodiment of the present invention.

[0019] In order to bond the nitride lighting structure **20**, a second bonding layer **31** is formed on the second substrate **30**. The material of the second bonding layer **31** is a metal chosen from any combination of Al, Ag, Au, Ni, Cu, Pt, Ti, and Pt formed by depositing, sputtering, electroplating and other known techniques. In the embodiment illustrated, the second bonding layer **31** is made of aluminum by depositing and having a thickness of 1 μm.

[0020] Figure 3 shows a schematic bonding of the high thermal conductivity substrate and the lighting structure of nitride according to the method for manufacturing nitride light-emitting device of the present invention. The method of the present invention requires bonding the second high thermal conductivity substrate **30** with the nitride lighting structure **20** with the first bonding layer **21** and the second bonding layer **31** fixed together face to face by setting a clamp thereon, and then applying a pressure in the directions indicated by arrows shown in the drawing. The first and second bonding layers **21**, **22** are bonded at a temperature of 300°C with a pressure of $4kg/cm^2$.

[0021] Figure 4 shows that the lighting structure of nitride is transferred onto the high thermal conductivity substrate according to the method for manufacturing nitride light-emitting device of the present invention. As shown in Figure 4, the first substrate **201** of the nitride lighting structure **20** is removed to expose the N-type nitride epitaxial layer **203**. In removing the first substrate **201**, any of a chemical etching, dry etching, and mechanical grinding is applicable and in the embodiment illustrated, the chemical etching is employed.

[0022] Figure 5 shows schematically a transparent conductive layer according to the method for manufacturing nitride light-emitting device of the present invention. As shown in Figure 5, a transparent conductive layer **4** is formed on the N-type nitride epitaxial layer **203** by depositing, sputtering, or plating, and the material of the transparent conductive layer **4** could be any of indium oxide, tin oxide, indium-tin oxide, zinc oxide, indium-zinc oxide, conductive nitride (CN), or magnesium oxide. In the embodiment illustrated, indium oxide is used.

[0023] Figure 6 shows schematically an N-type and a P-type electrode according to the method for manufacturing nitride light-emitting device of the present invention. An N-type electrode **5** and a P-type electrode **6** are formed on the transparent

conductive layer **4** and the second high thermal conductivity substrate **30**, respectively, by depositing. Other than depositing, sputtering or plating is also possible to form the N-type electrode **5** and the P-type electrode **6**.

[0024] Figure 7 shows a flowchart according to the method for manufacturing nitride light-emitting device of the present invention. A nitride lighting structure **20** and a second substrate **30** are provided in the method for manufacturing a nitride light-emitting device of the present invention.

[0025] For a chip bonding step 75 to be performed later, a step 71 and a step 73 are proceeded at start simultaneously to deposit a first bonding layer **21** and a second bonding layer **31** on a P-type nitride epitaxial layer **205** of a nitride lighting structure **20** and on a second high thermal conductivity substrate **30**, respectively.

[0026] The bonding step 75 is performed by setting a clamp on the first and second bonding layers **21**, **31**, and then fixing them together face to face with a predetermined pressure to have the nitride lighting structure **20** transferred and laid on the second high thermal conductivity substrate **30**. The bonding operation is performed at a temperature of 300°C with a pressure of $4kg/cm^2$.

[0027] A next step 77 for forming a transparent conductive layer **4** is to remove a first substrate **201** of the nitride lighting structure **20** to therefore expose an N-type nitride epitaxial layer **203** of the nitride lighting structure **20** and form the transparent conductive layer **4** on that N-type nitride epitaxial layer **203**.

[0028] A final step 79 for forming electrodes is performed to form a N-type electrode **5** and a P-type electrode **6** on the transparent conductive layer **4** and the second substrate **30**, respectively.

[0029] In the above described, at least one preferred embodiment has been described in detail with reference to the drawings annexed, and it is apparent that numerous changes or modifications may be made without departing from the true spirit and scope thereof, as set forth in the claims below.